



ALTERNATE TRAJECTORIES

OPTIONS FOR COMPETITIVE SOURCING OF THE SPACE SHUTTLE PROGRAM

DOCUMENTED BRIEFING



PART ONE

OVERVIEW AND BACKGROUND

Outline



PART ONE: Overview and Background of Study

- An Overview of Task Force Activities
- The Market and Liability Environment for Shuttle Operations

PART TWO: Evaluating the Shuttle Program

- Shuttle Safety and the Prospects for Competitive Sourcing
- A Full Cost View of the Space Shuttle Program
- Shuttle Operations in a Competitive Sourcing Environment
- Policy and Legal Issues

PART THREE: Competitive Source Strategies

- Options for Competitive Sources
- Competitive Factors

PART FOUR: Conclusions and Recommendations

- Conclusions
- Recommendations

ORGANIZATION OF THE DOCUMENT

This study by the Shuttle Competitive Sourcing Task Force examines the future of the Space Shuttle Program (SSP) with respect to potential avenues for shifting a greater share of the system into commercial hands.

This documented briefing presents the results of the Task Force analysis. The body of this documented briefing has four parts. The first provides a historical and policy overview for the Task Force's activities, describes the Task Force purpose and membership, and explores the market and liability contexts for considering options for commercializing or privatizing the Space Shuttle.

Part Two contains four sections. Each provides results of the Task Force assessment of key aspects of the Shuttle program—safety issues, costs, operational concerns, and the policy and legal ramifications of commercialization.

Part Three discusses the options identified by the Task Force for potential commercialization or privatization of key aspects of Shuttle management, operations, and infrastructure. It also identifies important factors that affect the viability of the various options.

Part Four presents the Task Force's conclusions and recommendations.

Task Force Purpose and Team Organization



- **Study directives:**
 - 1) *Identify* options for competitive sourcing of the Space Shuttle Program (SSP)
 - 2) Evaluate the comparative strengths and weaknesses of these options
- **Study purpose:**
 - Conduct truly “independent” evaluation
 - Previous studies conducted by NASA, ex-NASA, or SSP contractor personnel
 - To avoid any question of bias, participants must have no vested interest in outcome
 - Utilize personnel with “private sector business backgrounds”
 - To attract private sector participation in competitive sourcing, must understand private sector business needs & requirements
 - Address all areas of expertise needed to make sound business decision

OVERVIEW OF TASK FORCE ACTIVITIES

The Space Shuttle Competitive Sourcing Task Force was created in response to a request by NASA.

NASA directed the Task Force to:

- Identify options for competitive sourcing of the SSP.
- Evaluate the comparative strengths and weaknesses of these options.

The study was designed to produce a set of options that NASA would evaluate and choose among, and the Task Force was specifically enjoined from selecting or recommending a particular option. The related topics of Shuttle privatization or commercialization had been extensively studied and several reports are available for public review. The purpose of this review was to provide NASA with a new Task Force and independent evaluation. Task Force participants were selected that had no vested interest in the outcome of the analysis.

Task Force Membership



Name	Title	Affiliation	Team	RAND Staff
George Baker (NASA Cognizant)	Senior Advisor for Space Access	NASA	Strategy	Peter Wilson, Steve Berner
Bretton Alexander (OSTP Cognizant)	Assistant for Aeronautics and Space	OSTP		
Liam Sarsfield, CHAIRMAN [1]	Senior Analyst	RAND		
Owen Barwell [1]	Principal Consultant	PricewaterhouseCoopers	Safety	Dave Ortiz, Skip Williams, Julia Warner
Jack Donahue	Raymond Vernon Lecturer in Public Policy	Harvard University/Kennedy School of Government		
Robert Sieck	Shuttle Launch Director (former)	NASA (Retired)		
Pierre Thuot	Executive Vice President/COO	HawkEye Systems	Market/ Finance	Steve Berner, Jim Dryden
Francis DiBello	President/CEO	Florida Space Finance Corporation		
Michael Miller [2]	General Partner	SpaceVest Fund, LP		
Patrick Ciganer [1]	Managing Director	BV Group Ventures, LLC	Cost	Liam Sarsfield, Thor Hogan, Jeff Drezner
Patrick Ciganer [1]	Chief Financial Officer	Mobileway Inc.		
Steven Cohen	Acting Director (former)	OPM (Retired)		
John Vinter	President	International Space Brokers	Human Resources	John Ausink, Joe Guzman
Daniel Heimerdinger	Executive Vice President	Valador, Inc.		
Michael Lembeck	Group Vice President	Team Encounter, LLC		

[1] - At the time of this report these members have joined NASA's senior staff.
[2] - Currently Managing Director, ComSpace Development, LLC.

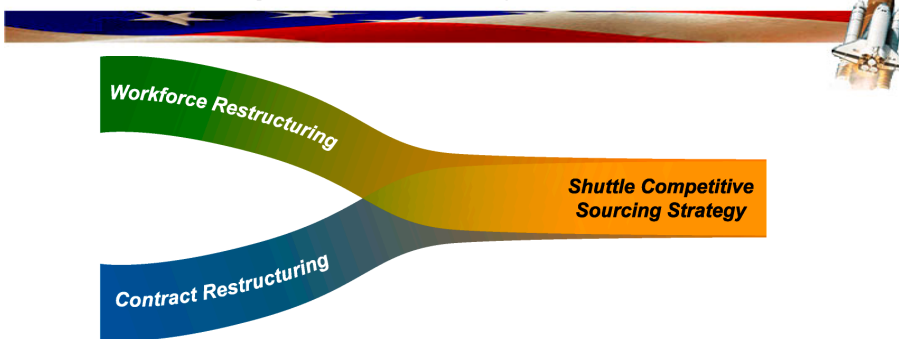
The Task Force members appear in the slide above. They were selected in consultation with, and subject to the approval of, NASA.

Task Force members were selected to represent a wide range of space-related expertise. To evaluate private-sector participation in various competitive sourcing options, it was imperative that commercial business needs and requirements be incorporated during deliberations. Many of the Task Force members had longtime experience in the private sector. Understanding the development and operations of aerospace systems was also vital and members were included with extensive experience with spaceflight systems. An appreciation of the concerns of NASA's workforce was reflected in senior Task Force representation in the domain of federal human resources. Most important, an understanding of flight safety and operations of the Shuttle itself was assured by selecting Task Force members who had flown on and directed operations of the Shuttle system.

The Task Force was supported by a team of RAND senior researchers under the auspices of RAND's Science and Technology Policy Institute (S&TPI). To facilitate the many detailed assessments, the Task Force and the RAND support personnel were assigned to discipline-oriented teams. These teams analyzed Shuttle program costs, personnel, and facilities. Throughout the study, the RAND team worked closely with the Shuttle program's NASA and contractor staff to prepare quantitative and

qualitative reports at the behest of Task Force members. The Task Force also solicited information from a broad sector of the Shuttle community, including potential future customers. The Task Force believes that this study represents the most comprehensive analysis of potential commercial operation of the Shuttle yet conducted.

What Does Competitive Sourcing Mean in SSP Context?



- The study of competitive sourcing options went beyond considerations of A-76 actions on the NASA SSP side:
 - It included examining the contractor base for the Shuttle
 - The objective was to help ensure a competitive foundation for the Shuttle program, while keeping in mind ongoing shifts in both the SLI and ISS programs

The term *competitive sourcing* has a specific meaning in government circles and the definition is quite narrow:

Competitive Sourcing—is the act of exposing government activities to competition with the private sector. The process of competition provides an imperative for the public sector to focus on continuous improvement and removing roadblocks to better performance and greater efficiency. The objective is to focus on the most effective and efficient way of accomplishing the agency's mission regardless of whether it is done by civil servants or contractors.¹

Implied in this definition is overlap in the function performed by comparable workers in the government and private sector. The Task Force found, however, that within the SSP, a program already heavily outsourced, there is actually little functional overlap between government and contractor managers and employees. Therefore, the Task Force concluded that the definition of competitive sourcing should be broadened to include new contractual relationships between the government and the private sector.

¹Lentz, L., "Competitive Sourcing: The FAIR Act and OMB Circular A-76," briefing the NASA HQ staff, March 2002.

Goals of Shuttle Competitive Sourcing



- **There are five goals guiding Shuttle competitive sourcing**
 - **Ensure the safe transport of humans to/from orbit**
 - **Enable NASA to exit the business of operating human space assets**
 - **Enhance competitive environment**
 - **Open up a cost wedge for reinvestment**
 - **Reinvigorate NASA as an R&D organization**

To guide Task Force deliberations and to ensure that studies and analyses remained focused on the desired outcome, the Task Force culled from guiding documents a set of goals for competitive sourcing. These goals were vetted with NASA, OSTP, and Office of Management and Budget (OMB) officials as the Task Force began its initial series of meetings to ensure that they were acceptable to OSTP, OMB, and agency officials.

Ensure the safe transport of humans to/from orbit. Although the Shuttle has proven its reliability, launching humans into space remains risky. It is unlikely that the risks associated with operating the Shuttle will be dramatically reduced, though some modifications could improve safety. The ramifications of a Shuttle accident are severe, both in terms of loss of human life and national infrastructure. As NASA evaluates options for competitive sourcing, a focus on safety must be preserved. The goal should not be to just maintain current levels of safety, but to ensure that a competitive sourcing initiative leads to improvements.²

Enable NASA to exit the business of operating human space assets. The civil space program will increasingly rely on the private sector to provide

²National Aeronautics and Space Administration, Office of Space Flight, *Space Shuttle Program: 2000 Annual Report*, Washington, D.C., 2000.

services. Today, launching humans into space is a government endeavor, but this is a capability that could be transferred to another agent. This transfer represents the natural progression of government high-risk undertakings that mature to become commercial operations. This strategy helps to build a strong and more capable industrial sector, a key to preserving the U.S. competitive position in world markets.

Enhance the competitive environment. Competition and free choice are basic tenets of the U.S. economic system. Competition is good for government agencies and private firms alike in that it promotes efficiency and innovation. It can be pursued along with other goals that promote safety and performance improvement. While a competitive environment cannot always be achieved in practice, the pursuit of a free and open competition benefits both government and industry.³

Open up a cost wedge for reinvestment. While reducing cost is not an express goal of competitive sourcing, it is important that the Shuttle program not grow beyond the budget blueprint that policymakers have established for the program. The Shuttle system, now more than 20 years old, will require updating. This goal reflects a desire to employ competitive sourcing, directly and indirectly, to help generate the financial savings that can help fund efforts to maintain and improve the Shuttle system.⁴

Reinvigorate NASA as a research and development (R&D) organization. NASA, and its predecessor NACA, was established to conduct R&D that would yield scientific discoveries and develop technologies that would serve the U.S. taxpayer and the broadest interests of mankind. It is imperative that NASA remain focused on this mission. In pursuit of its R&D mission, the agency sometimes must embark on activities with an operational emphasis. Protracted operations can, however, divert resources from its prime role and should not be encouraged. The Shuttle program (the largest within NASA) draws upon a large number of civil service employees. If leadership of the Shuttle program can be successfully transferred to another agent, precious NASA resources can be redirected to existing and new programs of space exploration.⁵

The Task Force realizes that some aspects of these goals are potentially contradictory. Competition in the marketplace can, for example, lead to operator changes that could impair safety. Contractor stability is an important element of reliable, safe operations. Another example:

³See Office of Management and Budget, *President's Management Agenda*, January 2002.

⁴This guidance was provided to the Task Force by officials of OMB and OSTP.

⁵See O'Keefe, S., "Competitive Sourcing," memorandum to NASA staff, Washington, D.C., July 11, 2002.

transferring responsibility to the private sector could erode NASA's core competency in areas needed to reinvigorate the agency's R&D initiatives. Where contradiction does or could exist, NASA senior management and other administration senior officials must determine the priorities for the agency.

There Are 12 Evaluation Measures and Criteria



- **Provide for safer operations**
- **Engender positive cultural change**
- **Broaden the competitive contractor base**
- **Reduce transaction costs**
- **Provide flexible and robust operations**
- **Promise savings leading to reinvestment**
- **Create clear lines of authority and responsibility**
- **Reduce implementation complexity**
- **Promote innovation within Shuttle system**
- **Encourage independent contractor operations**
- **Free up NASA civil service resources**
- **Meet diverse future and unanticipated requirements**

Potential contradictions are inherent in any set of ambitious goals, however, and this fact only reinforces the need for NASA to carefully analyze the various competitive sourcing options. There are no ideal solutions in regard to competitive sourcing because the decision environment is extraordinarily complex. Objectively selecting among the various options requires a set of evaluation measures. The Task Force recommends the following set of twelve:

Provide for safer operations. Safety cannot be compromised in a transition to competitive sourcing strategies. Though they are difficult to quantify, factors that form a foundation for safe operations should be carefully evaluated when reviewing the various competitive sourcing options.

Engender positive cultural change. NASA must avoid becoming an operational agency since such an outcome would threaten its primary scientific and technological role. Some competitive sourcing options are better than others at bringing about cultural transformation within NASA that leads to the desired R&D focus.

Broaden the competitive contractor base. As one of NASA's older programs, the Space Shuttle has an established contractor base. While it will be difficult to expand that base, options that do so, or that enhance

competition among existing suppliers, offer distinct advantages over those that do not.

Reduce transaction costs. Operating a complex system like the Space Shuttle is expensive from a management and operations point of view. Competitive sourcing options that could provide a less expensive way of managing and operating the Shuttle system are desirable.

Provide flexible and robust operations. The Shuttle represents a highly capable and reliable launch system. With a good deal of uncertainty surrounding the future of the space program, the Shuttle system could prove to be a critical enabling resource. Options for competitive sourcing that preserve flexibility in terms of meeting requirements and that provide additional operational capability over a longer period of time are superior.

Promise savings leading to reinvestment. Cost savings may not be an express goal of competitive sourcing, but it is important that budget increases be avoided. It is likely that, as the Shuttle system continues to age, additional funds will be needed to support the program. Competitive sourcing options that offer the potential for savings that enable reinvestment are advantageous.

Create clear lines of authority and responsibility. Operational efficiency, safety, and stability are best achieved by organizational structures that demonstrate streamlined features and clear focus. Competitive sourcing options that present a lean, streamlined structure that permits authority and responsibility to be clearly aligned is advantageous.

Reduce implementation complexity. The fact that the Shuttle represents a highly complex system is inescapable; however, some options may offer simpler ways to manage and operate this system. When the same outcome is achieved, the simpler option is desirable.

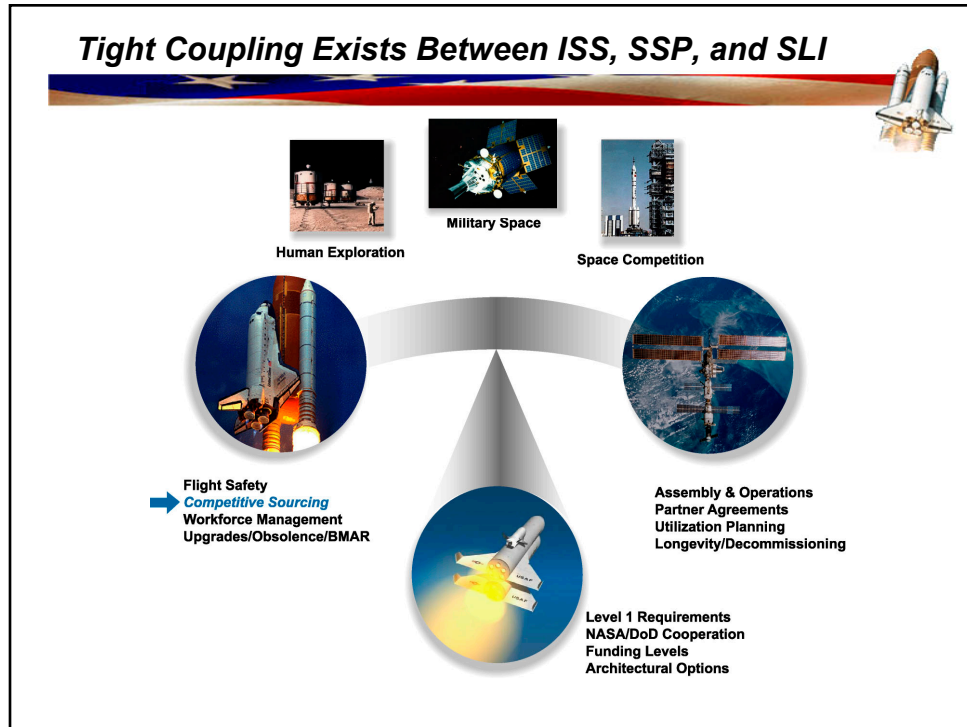
Promote innovation within Shuttle system. Innovation need not be focused on performance or engineering improvements. Competitive sourcing options might provide organizational or functional innovations that allow the Shuttle to be operated more safely and at lower cost. Options that promote innovation in this way have an advantage.

Encourage independent contractor operations. Competitive sourcing options vary in the degree to which NASA remains involved in Shuttle operations. It is desirable to free NASA from functions that can be transferred to contractors. This encourages private sector capabilities and allows the government to acquire transportation services at some point in the future.

Free up NASA civil service resources. Coincident with the goal of ensuring that NASA remains focused on R&D is the concept of freeing civil service resources from Shuttle operational responsibilities. Options that reduce the number of civil servants who must remain, in whole or in part, with the Shuttle program have an advantage.

Meet diverse future and unanticipated requirements. No one can be certain how the Shuttle program will continue to evolve, or what requirements could be placed on the system by changing agency or national requirements. Some competitive sourcing options offer a better capability to respond to uncertain requirements.

Clearly defined goals and evaluation criteria will aid NASA in selecting a competitive sourcing option. Agency leaders will have to prioritize requirements and weigh the evaluation criteria to select an option that best aligns with NASA's strategic direction.



It became apparent early during the Space Shuttle competitive sourcing study that any option selected would ultimately have to be evaluated and chosen in the context of a much larger set of strategic choices for NASA. The Space Shuttle is the vital transportation system for the construction of the International Space Station (ISS). Only the Shuttle has the volume, payload, and human passenger capacity to facilitate the assembly of the large components of the ISS. Furthermore, the Shuttle will continue to provide logistic support to the long-term operations of the ISS as an orbital laboratory. Once the ISS is completed within approximately the next five years, the question is how long the Shuttle will remain the primary logistics system. The number and character of Shuttle flights over time will depend upon still unresolved strategic questions about the character of future ISS operations. Outstanding issues such as the long-term steady-state crew size of the ISS remain unresolved at this time.

Nor can decisions be made regarding competitive sourcing of the Space Shuttle Program without consideration of the time frame over which NASA plans to continue to use the Shuttle. At present, the planned continued use of the Shuttle is targeted by NASA out to 2012, but some planning scenarios discussed with the Task Force posit continuing NASA's use of the Shuttle for 15 or 20 years or longer. This suggests that a strategic decision must be made by NASA leadership in the near future

regarding whether to invest in the Shuttle's replacement to provide a more efficient transportation system to support the ISS. It is hoped that the recently announced Space Launch Initiative (SLI) program will produce a space transportation system that is inherently much more safe and more efficient to operate than the Shuttle. On the other hand, a decision may be made not to rapidly replace the Shuttle and operate it as the primary ISS logistic vehicle out to the 2020 time period. A strategic decision by NASA on the lifetime of the Shuttle and the emergence of its replacement will have an important impact on the attractiveness—or lack thereof—of the various competitive source options examined by the Task Force.

Aside from the critical strategic decisions made by NASA on the future of the Shuttle, ISS, and SLI programs, the larger geostrategic and economic environment might alter national space policy plans and priorities. A variety of “strategic shock” scenarios might stimulate a major increase in the near-term need for the Space Shuttle and/or its SLI follow-on. Potential scenarios include: (1) a major in-orbit catastrophe for the ISS, (2) a major political military crisis that stimulated the United States to deploy space-based offensive and defensive weapons quickly, (3) a Chinese human landing on the moon at the end of the decade, and (4) a discovery on the ISS that leads to the need for greatly expanded space-based production infrastructure. The Task Force judged that one or more of these low-to-moderate probability scenarios were plausible but their effect on the U.S. space program might prove mixed at best. Even if one of the more dramatic events posited did occur, it still remained uncertain to the Task Force whether the event would act as powerful stimulus for a major increase in U.S. human spaceflight activity.

For example, the U.S. military might conclude that a cargo variant of the Space Shuttle was a useful heavy-lift vehicle to support the construction of a space-based ballistic missile defense (BMD) constellation. On the other hand, that would not lead to an increased demand for the Shuttle as a human transportation system. Another ambiguous example of a “strategic shock” would be rapid development of a robust Chinese human space flight program that lead to a lunar landing by the end of the decade. Such a historic event might stimulate a U.S. response to meet the “Chinese challenge.” On the other hand, U.S. and Chinese geostrategic relations might be sufficiently cooperative at that time to greatly mute any American public and/or elite alarm about this Chinese space success. As for surprises from the science produced by the ISS, the Task Force felt that most found would likely lead to new production processes on earth rather than call for creation of a new human-tended space-based production infrastructure.

Task Force Focus Differs From Prior Studies



- Examined an array of competitive sourcing options in the context of three major variables: 1) strategic launch architectures, 2) Shuttle operational functions, and 3) the maturity/capability of the private sector
- During the course of the Task Force's analysis it was found that the alternative governance models were of *secondary significance* while considering the costs and benefits of the various sourcing options
- As in other studies the issue of insuring safe human space flight activity was taken as a priority objective

Study	Date	Chair	Recommendations
National Academy of Public Administration (NAFA) Report	Dec-94	C. T. Newman	Focused on management efficiencies and estimated marginal cost of Shuttle launches to range from \$50 to \$100 million
Space Shuttle Management Independent Review Team (Kraft Report)	Feb-95	Christopher Kraft	A single prime should take over bulk on the shuttle flight process
HKA, LLC, "Analysis of Potential Alternatives to Reduce NASA's Cost of Human Access to Space"	Sep-98	Not identified	Effective introduction of private-sector incentives and disciplines, driven by profit motive, achieved only through assumption of risk by private sector – Shuttle high cost structure unattractive to private sector
Concept of Privatization of the Space Shuttle System	Sep-02	Ronald Dittmore	Proceed with privatization of the Shuttle system by pursuing either: modification of the current SFOC mechanism, formulating a Q-Corp, or an expanded competitive base
Final Report of the Space Shuttle Privatization Task Team	Dec-01	Joseph Rothenberg	Start-up and transition to any option will present significant management challenges; transfer of Shuttle assets to contractor may be deal killer, government retaining contractor's indemnification with only S&A insight difficult, contractor assuming all liability/insurance may
Boeing, "Shuttle Privatization Executive Summary"	Jan-02	Not identified	Support functional privatization of Shuttle program and Shuttle likely the only RLV until 2020
Space Policy Institute, "Privatizing the Space Shuttle Issues and Approaches"	Jan-02	John M. Logsdon	Prospect for Shuttle privatized dimmed by adverse turn in the commercial space launch market and bad experience by USAF with giving ELV design and manufacturing private sector responsibility
United Space Alliance (USA), "Shuttle Privatization"	Mar-02	Not identified	Expand SFOC's operational purview over large array of Shuttle operations → execute the recommendations of the Kraft Report

The Task Force examined the wide array of studies commissioned since the mid-1990s to examine Space Shuttle privatization options. Unlike these studies, the Task Force examined an array of competitive sourcing options in the context of the larger strategic choices about the future role of the Space Shuttle, operations for the ISS, and the timing and circumstance of any Shuttle replacement. Although the Task Force was not asked to formally evaluate the competitive sourcing options in the context of this strategic trade space, it did keep in mind this environment while evaluating the strengths and weaknesses of the various options.

The Task Force noted that most of these studies gave considerable emphasis to the governance models as an important element of their evaluation criteria. After considerable deliberation during the early phases of the study, the Task Force concluded that the alternative governance models were secondary choices, as each structural alternative can be governed in more than one way. The Task Force does acknowledge that, if one or more of the competitive sourcing options were chosen by NASA, a much more detailed evaluation of governance structures would be required before a final choice could be made.

Outline



PART ONE: Basis of Study

- An Overview of Task Force Activities
- **The Market and Liability Environment for Shuttle Operations**

PART TWO: Evaluating the Shuttle Program

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MARKET AND LIABILITY ENVIRONMENT FOR SHUTTLE OPERATIONS

To support Task Force deliberations, Task Force staff analyzed the current and potential markets for Shuttle services and assessed the implications of these for transferring portions of Shuttle operations and management to the private sector. The Task Force also looked at liability and insurance issues.

A key consideration for greater private-sector entry into Shuttle management and operations is the existing and potential market for Shuttle services. When the Shuttle was first envisioned, NASA projected a launch rate of close to 50 flights annually. The projected demand for the Shuttle included deployment of scientific spacecraft, military and intelligence gathering payloads, and commercial systems, including satellites and foreign payloads. The Shuttle, however, proved to be far more complex than first conceived and required a long period of learning and working myriad problems out of the system. Confidence in the Shuttle built steadily until the loss of the *Challenger* in 1986 crippled the program for approximately two and a half years. By the time the program came back to full operation, demand had evaporated.

In the years since, NASA and the contractor community have once again shown the Shuttle to be a robust system. NASA itself remains the Shuttle's primary customer, and its primary use is for building and servicing the ISS. The question now is whether potential emerging commercial markets will increase demand for Shuttle services.

Shuttle Can Address Several Potential Market Segments



- **Market segment for Shuttle missions includes:**
 - Construction/service of Space Station
 - Deployment/retrieval of NASA science payloads
 - Deployment of commercial satellites
 - Deployment of military satellite payloads
 - On-orbit assembly, repair, and servicing of satellites
 - Industrial research payloads
 - Space tourism
- **An additional market segment exists for management, operation, and support of the Shuttle**
 - This segment is served by government contractor base
 - NASA is currently the only buyer
- **Judgment on future state of demand determines what, if any, rational business models apply to these segments**

The Task Force evaluated the Shuttle market from two different perspectives: (1) the users of the Shuttle as a launch vehicle and platform for space services, and (2) markets associated with operating the Shuttle through suppliers of services and vendors for the Shuttle program. The first perspective focuses on Shuttle mission markets, the second on NASA as the buyer. Each of these market perspectives is distinct with its own functions, segments, and demand.

The Task Force defined a “market” as the set of all actual and potential buyers of relevant products and services. The term “market size” is relative, based on the level of the demand. Demand consists of interest in the product or service, availability of resources, and willingness of the buyer to offer these resources to buy the product or service. Market size and demand typically are characterized by a demand state, which can be negative (pay to avoid), none (no interest or indifferent), latent (strong need but service or product does not exist as yet), faltering, irregular (volatile fluctuations or timing mismatch with supply), full (current level and desired level equal), or overfull (demand exceeds supply).⁶ The Task Force tried to assess the demand state for each submarket segment.

⁶Definitions as provided from *Marketing Management-Analysis, Planning, and Control*, by Philip Kotler, 11th Edition, Prentice Hall, 2002.

The Task Force evaluated the Shuttle's unique capabilities to determine the segments associated with Shuttle missions. In the sense that the Shuttle deploys satellites or payloads, it is a launch service and can be compared with other launch vehicle service providers on a global basis. Although current government policy and law prohibit the launch of commercial satellites and certain types of payloads, the Task Force included this potential segment for review, recognizing that laws and policy can be changed to remove these barriers.

The Shuttle provides human spaceflight functions with the potential to open markets of construction, servicing, repair, retrieval, and tourism. Due to the close association of the ISS with the Shuttle program, construction and servicing of the ISS was deemed to be a segment in its own right. This segment is characterized by the need for multiple missions over a period of time, but only NASA buys these missions.

The market segment for management, operation, and support of the Shuttle falls into its own category because it has only one buyer—NASA—supported by a cadre of vendors and service providers. Of particular interest in this segment are the organizational structure of this support base and the way NASA buys its services. The Task Force separated this segment in order to clarify the different business models associated with providing operating services to a single buyer in NASA, versus a large potential pool of buyers for Shuttle missions. The two perspectives merge when evaluated under business models in which private entities control both the provision of launch services on the Shuttle and the means of delivering those services.

For the market segments for Shuttle missions, the Task Force used its judgment along with reference materials and experience to determine demand and potential buyers in the current environment and in the future.

Space Station Is the Only Credible Near-Term Demand



- Space Station market can be used to provide reliable, long-term demand for four Shuttle missions per year
- Reasons for caution regarding other market segments are as follows:
 - For non-space Station NASA payloads, only a handful are planned
 - For commercial satellites:
 - No Shuttle upper stages are in production for GEO comsats
 - Payloads would require reengineering
 - Demand for launch of commercial satellites is flat
 - Significant excess of commercial launch capacity now exists
 - For military satellites:
 - No Shuttle missions are currently manifested
 - Military and private segment have just made major investments in EELV
 - Planning for military launches centers on use of EELV
 - Satellite repair and servicing missions cannot be forecast
 - While latent demand may exist for space tourism, on-orbit assembly, & private research payloads, these segments are too immature or undeveloped at this time to build a business around them
- Development of additional market segments will require significant effort and investment
 - Provision of additional Shuttle missions (above Station missions) at marginal-cost pricing and use of a commission-based marketing agent may also help

The current Shuttle manifest as well as ISS plans show that the Shuttle's main use for the next decade will be building and servicing the ISS. The base number of dedicated missions dedicated to the ISS is four per year, but that could change, depending on available funding, use of the ISS, and alternative sources to supply/resupply the ISS. The programs are integrally linked with the Task Force assessing that neither could be sustained in the market without the other.

Demand state assessments for the other Shuttle mission segments noted that very few missions are currently planned. As of today, only one Hubble servicing mission is planned and no science payloads dedicated to a new specific primary Shuttle mission have been approved or funded. However, there are several large science payloads in early planning stages, which may require the odd Shuttle mission several years in the future.

The Task Force assessed the viability, barriers, and demand state of the commercial satellite market. Today's launch vehicles provide services to geostationary transfer orbit, whereas the Shuttle only provides low-earth orbit (LEO) deployments. Upper stages that were previously used for 1980s era satellites are no longer in production, nor are the satellites that were designed to integrate with them. Current payloads are not designed

for the Shuttle environment and would need reengineering from both a launch dynamics and safety perspective.

Over the past few years, the market forecast for satellite payloads has been dramatically reduced. In addition, launch services is a highly competitive international market with multiple vehicles available sized to the buyer's demand. This current faltering demand market coupled with the oversupply of current launch vehicles led the Task Force to believe that it would be extremely difficult for the Shuttle to compete favorably in this segment.

Likewise, military users show only limited interest in Shuttle services. The military has invested heavily in the Evolved Expendable Launch Vehicle (EELV) program, which provides for two competing launch vehicles, the Delta 4 and Atlas 5. While future military requirements could require Shuttle capabilities, there are no current plans to use it. Of course, some major change in policy or national defense requirements could change the situation, but there is no way to assess the likely impact.

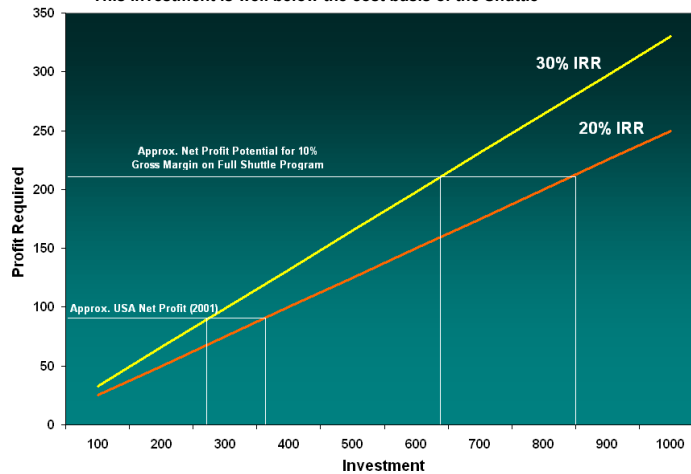
The Task Force judged that latent demand may exist for some unique market segments, such as satellite repair and servicing, on-orbit assembly, or space tourism. However, significant investments would be required to develop these markets, for which viable business models have not been built. Therefore, forecasts for these types of missions would be highly speculative.

Stimulating new commercial demand for Shuttle missions would require competitive pricing, new investment, and solid business planning in the market. These types of new business might be developed through marketing agents or business development organizations.

Private Investment Is Tied to Requirement for Significant Profit



- NASA demand for Space Station missions could possibly be structured in a way that might justify some level of private investment:
 - Guarantee of 4 flights/year could form the basis of a business
 - Ability to provide long-term guarantee is a question
 - One-time investment on the order of \$0.5–\$0.75B could make financial sense if sustainable (7–10 year) 10% pre-tax profit margins are anticipated on full cost of Shuttle Program
 - This investment is well below the cost basis of the Shuttle



What is the likelihood that private firms or investors would invest in the Shuttle and under what conditions? To address this issue, the Task Force evaluated the current implied cost structure of Shuttle operations against the current implied revenue model for Shuttle missions.

The first part of this analysis noted that a hurdle Internal Rate of Return (IRR) is required on any upfront investment. Equity investors typically would require a minimum of 20–30 percent IRR to account for the inherent timing and operational risks of cash flows associated with any private ownership of the SSP. Second, available public information on the profits generated by the key Shuttle contractors was combined with typical government contractor profitability to provide approximations of the total net cash flows available in the Shuttle program. It was assessed that the total industry after-tax profits on the Shuttle were approximately \$200 million, with United Space Alliance (USA) counting for almost \$90 million of this.⁷

⁷Boeing's 2001 annual report stated operating earnings of \$72 million in 2001 from its 50-percent partnership in USA. This would put USA's total operating earnings at \$144 million in 2001. At a federal corporate tax rate of 35 percent and an average state corporate tax rate of 5 percent, this would result in \$86.4 million in after-tax profits.

With this information, we plotted potential investment a company might make in order to generate profitable returns from operating the Shuttle program. The chart can be used to derive the maximum potential investment to generate this profit under the two IRR scenarios.

A one-time investment of less than \$1 billion would be theoretically available to receive the cash flows available from the entire program. This would not cover the Shuttle upgrades, obsolescence, or infrastructure maintenance costs. Overall, it is well below the cost basis of the Shuttle program.

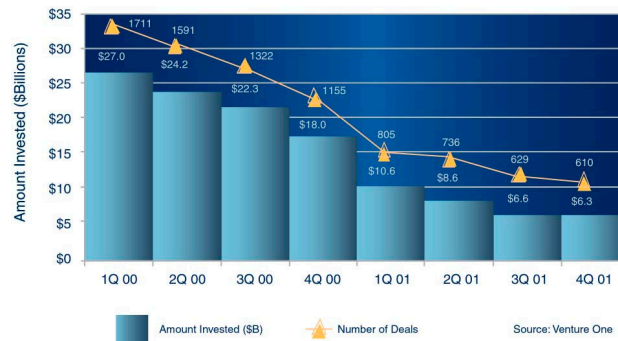
This analysis implies that there is not enough profit potential in the program to justify private ownership/operation. Or, heavy subsidization would be required to attract private investors to take on the risk of generating profitable mission revenues above the current costs of operations and maintaining a healthy program in the future.

However, this is a level of investment that might be applied to market development of incremental Shuttle missions in which the private sector could receive a profit at the margin.

Timing Is Poor to Seek Private Investment



- **Large recent losses and high-profile space-related bankruptcies**
 - New satellite services for voice and data failed
 - New innovative launch vehicle developments unable to raise capital
- **Bond markets have essentially disappeared in satellite/telecom/space sector, stunting infrastructure investment**
- **Venture capital for new innovative ideas is in rapid decline**



The previous chart suggested that a modest potential exists for investment by the private sector under the right conditions. However, the overall risk tolerance of the market for investment in space-related activity is low at present.

In assessing the potential for private investment in the Shuttle program, the Task Force noted the recent downturn for venture and private investment in related industries such as high technology and telecommunications. The large financial losses and bankruptcies in recent space-related satellite ventures have caused an even more severe investment gap for innovative space ventures. From an investor viewpoint, the near future will require low-risk business plans and models that ensure significant returns and predictable cash flows. The innovative segment of the space industry has not been able to deliver this in the past. The timing for seeking private investment in the Shuttle program is very poor.

Market Prospects Are Constrained and Unlikely to Improve



- **NASA remains dominant customer and servicing International Space Station is predominant use**
- **Commercial markets are immature and show little likelihood of growing in near-to-mid future**
- **Commercial communication satellites unlikely to increase demand for Shuttle services**
- **Military and intelligence users have no long-term plans for Shuttle use**
- **Internal market—suppliers—constrained by lack of competition and stiff entry barriers**

Overall, demand for Shuttle services is unlikely to grow. SSP's dominant customer is NASA itself, and the primary use of the Shuttle is building and servicing ISS.⁸ Prospects for broadening this customer base appear discouraging.

Commercial markets, such as satellite servicing and the development of commercial space stations are immature and unlikely to build a substantial revenue stream in the near-to-mid-term. Space tourism is also unlikely to demand Shuttle services. Space tourism is a small market consisting of an unknown number of very wealthy individuals who can afford a ride into space.

The deployment of commercial communication satellites, even if the national space policy restrictions were removed, would not reestablish a viable source of demand for Shuttle services. Satellites have to be designed to be launched from the Shuttle due to the different way that structural loads are imparted to the satellite from its mounting within the Orbiter's payload bay. Also, the Shuttle's low orbit requires that the satellite must carry an upper stage to boost it to a higher geosynchronous

⁸NASA's Space Science Enterprise projects a need for one Shuttle flight every three years; the remainder of the Shuttle manifest is completely dominated by the ISS.

orbit; these booster stages are no longer in production. Finally, the failure of the LEO communications market and the longer-life and greater performance of modern communication satellites has reduced the number of satellites being launched, causing excess capacity, and therefore competitive pricing, in the ELV market. The market price for satellite launches, in short, has fallen to well below the cost of providing such services on the Shuttle.

Military users, too, are unlikely to place significant demands on the Shuttle. Both DoD and the intelligence community have no long-term requirement for “humans-in-the-loop” to deploy or operate their payloads. DoD has also invested heavily in the development of the new EELV, a fleet of new high performance, high reliability launchers. The Task Force was only able to identify a limited DoD interest in the Shuttle, mainly for the occasional deployment of small technology demonstrator type satellites.

The primary reason for the lack of interest in the Shuttle is the cost and complexity of using the system. At a full annual cost of \$3.8 billion and a launch rate of four to six missions per year, the average cost is very high. The nature of a Shuttle launch varies widely, making it very difficult to calculate the marginal cost of a launch—that is, the costs that are solely attributable to one additional launch, excluding all fixed costs. The marginal cost is generally thought of as the benchmark for pricing a service. Previous studies have placed the Shuttle’s marginal cost between \$100 million and \$150 million per launch.⁹ This is above the cost of all but the largest of expendable launchers. So even if the government meets all costs other than those strictly due to the extra launch, the Shuttle’s economics compare unfavorably with ELVs. Processing the Shuttle and its payloads is also necessarily complex. Although NASA has made substantial investment in fleet modernization, and has streamlined procedures in many areas, flying the Shuttle is an exceedingly time-consuming task—a further deterrent to commercial demand for its services.

Beyond the demand for Shuttle in the external market is consideration of the internal market—the supplier base—and competition for the current \$3.2 billion in NASA extramural spending. The Shuttle program is served directly by nearly 200 companies.¹⁰ The majority of these contracts are less

⁹National Academy of Public Administration, *A Review of Space Shuttle Costs, Reductions Goals and Procedures*, Washington, D.C., 1994.

¹⁰These are companies with Shuttle contracts managed by NASA. Hundreds of other firms are involved in the Shuttle program as subcontractors to the prime contract firms.

than \$500,000. Many of the largest contracts are sole-source supply contracts to procure the Space Shuttle flight elements. The largest contract, the Space Flight Operations Contract (SFOC), is approximately \$1.5 billion, which equals 47 percent of program extramural spending. Although this contract is designed for periodic recompetition, there are daunting barriers to the entry of serious rivals to the incumbent contractor. Together, these factors create a situation in which there are very few bidding opportunities for contracts of substantial size. Changing contract structures does not necessarily improve competition. SFOC is currently serviced by USA, a joint venture of Boeing and Lockheed Martin. The creation of USA, essentially reflecting a cartel agreement between America's two largest aerospace firms, puts in place a firm with tremendous market leverage. The net result of the current structure is that Boeing and Lockheed Martin together secure two-thirds of SSP's \$3.2 billion extramural budget. Incumbent contractors with high award fees and a long-term relationship with NASA are the trademarks that constrain outsider firms from bidding.

Implications of Market Assessment



- **NASA is the only predictable customer for space Shuttle missions for the near- to mid-future**
 - Competitive sourcing options must function in a single-buyer environment
- **Private sector acquisition of major Space Shuttle Program assets is unlikely unless market risk and business risk are reduced**
 - Long term commitments and guarantees for purchase of Shuttle missions
 - Emergence of new Shuttle markets
 - Existence of significant profit potential
 - Reduced risks of obsolescence and orbiter loss
- **In the near term, competitive sourcing is limited to options that do not involve large-scale asset transfer**

The Task Force could not identify potential new markets for Shuttle sources that are at once plausible, short-term, and significant in scale. The ISS is the only reliable customer for Shuttle missions, and any added missions are very likely to come from NASA. Competitive sourcing options must be assessed with this single-buyer environment in mind.

Shuttle assets are unlikely to transfer to the private sector unless risks are abated. New Shuttle markets added to a guaranteed Space Station market will help. The opportunity to make a profit sufficient to justify assets employed and incremental capital outlays is essential. And the risks due to obsolescence and orbiter loss must be viewed as controllable.

Insurance Facility Has Existed Since SSP Inception



- **Since early eighties, NASA recognized insurance market limitations and problems associated with settling claims:**
 - Liability insurance facility set up in the 1983 time frame:
 - Available to all shuttle users; currently not in use
 - Inter-Party Waiver arrangement between all parties developed:
 - Commercial users have risk of loss for their property or people
 - Commercial insurance purchased by users
- **NASA bore risk of loss for government property, including orbiter:**
 - Insufficient capacity to fully cover loss of Shuttle assets
 - NASA/US Government is/was “self-insured”
- **Commercial users were required to purchase Third Party Liability (TPL) insurance:**
 - \$500,000,000 to be shared by all users on a flight
 - Alternatively, the amount to be purchased could be reduced to the amount of insurance available in the world market at a reasonable price
 - Government indemnification under Section 308 of Space Act
- **Bottom Line—the framework of a facility exists:**
 - Competitive sourcing could be built on this facility—could include 3rd and 1st party liability elements

In addition to the market environment, the Task Force examined the liability environment and availability of insurance under alternative sourcing arrangements.

NASA has been involved in the indemnification of space launches since the early days of the space program. As the Space Shuttle entered service, early concepts envisioned extensive commercial operations. NASA and the insurance industry created a facility—a pool of insurance assets—to provide liability insurance to Shuttle users in 1983. The facility was made available to all Shuttle users, providing \$500 million of third-party insurance shared by users on a given flight and covered the users as well as the U.S. government.¹¹ Indemnification above this amount was supplied by the government under the Space Act.¹²

However, this third-party insurance facility has recently lapsed. The last policy ran from December 1, 2000, to December 1, 2001, and was not renewed. The Task Force found that this facility could be reformulated if competitive sourcing was pursued by NASA and required such insurance.

¹¹The \$500 million value is available based on any one occurrence. A sublimit of \$25 million is available in terms of liability to crewmembers.

¹²Section 308 of the 1980 NASA Authorization Act (Public Law 96-48).

3rd Party Liability Funding Is Available



- Although not currently applied to the Shuttle, the Commercial Space Launch Act establishes a regime (49 U.S.C. Subtitle IX, Chapter 701) that would facilitate a private firm operating the Shuttle
- There is adequate 3rd Party Liability capacity in the market up to the existing \$500M limit—government indemnifies above this limit

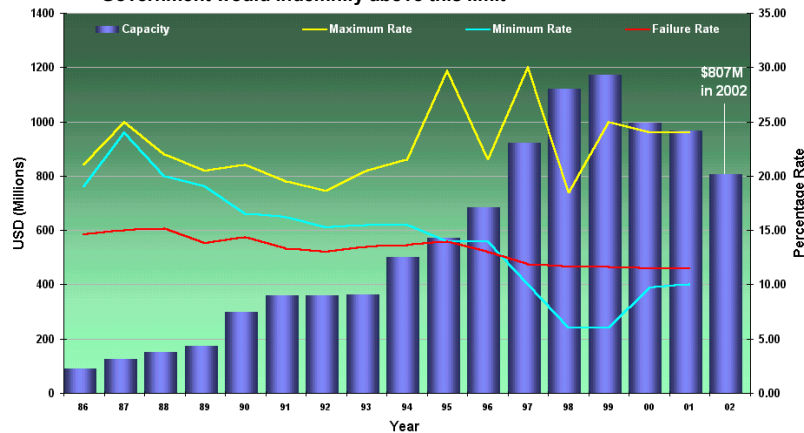
Insurance Market Source	Maximum Expect Loss of \$500,000,000	Total Capacity
London Market		
ACE Global Markets	20%	\$100,000,000
Westminster Aviation Insurance Group	15%	\$75,000,000
Global Aerospace Underwriting Manager (AAU and BAIG)	20%	\$100,000,000
HISCOX	3%	\$15,000,000
Wellington	25%	\$125,000,000
Amlin	10%	\$50,000,000
Chartwell	7%	\$35,000,000
Chaucer	5%	\$25,000,000
KILN	8%	\$37,500,000
<i>Subtotal</i>		\$662,500,000
U.S. Market		
Brockbank	15%	\$75,000,000
USAIG	15%	\$75,000,000
American International Group (AIG)	15%	\$75,000,000
<i>Subtotal</i>		\$225,000,000
Other Markets		
Hannover Re	0%	\$0
La Reunion Spatiale	0%	\$0
<i>Subtotal</i>		\$0
TOTAL		\$787,500,000

The majority (71 percent) of third-party capacity is generated by London-based firms; the remaining firms operate in the United States. In combination, the capacity for spaceflight insurance is approximately \$787 million in 2002.

Private Operators Could Share 1st Party Liability



- Market capacity continues to decline—reached \$807M in '02
 - Can support a maximum estimated 1st party loss of Shuttle of \$250M
- This is sufficient for NASA to apply “shared liability” concept:
 - Operator's potential liability tied to revenue:
 - Could buy a policy (not recoverable under contract) or self-insure
 - Government would indemnify above this limit



The Failure is based on Total Loss and Constructive Total Loss for Commercial Communications Satellites.
The data for "Failure Rate" is based on the number of satellite failures against the number launched from 1981 on an "all time" basis.

A critical issue in relation to competitive sourcing is the potential for property damage to the orbiters, or other elements of the Shuttle system, under private-sector operations. Whether or not a competitive sourcing option involves asset transfer, Shuttle infrastructure will be at risk and first-party liability concerns must be addressed. Traditionally, NASA has borne risk of loss for the fleet and its associated infrastructure against property damage. Since it is unlikely that a commercial source would be able to replace elements with such high asset value, some form of NASA indemnification will continue to be required. However, competitive sourcing places the private sector in a leadership role in relation to Shuttle operations. Under the principles of competitive sourcing can the private sector be asked to carry at least some of the risk of loss?

The Task Force reviewed the many aspects of liability associated with Shuttle operations and found that it is reasonable for NASA to pursue a strategy of “shared liability” with the private sector. The figure above tracks the market capacity for first-party losses from 1986 until today. Capacity peaked in 1999 at close to \$1.2 billion and has declined in recent

years.¹³ The estimated capacity in 2002 is \$807 million. The Task Force then attempted to ascertain what percentage of this capacity could be reasonably raised to insure for Shuttle property damage. Based on this assessment, the Task Force concluded that about \$250 million could be provided by the insurance industry to support commercial Shuttle operations. The government would, of course, bear risk of loss above this limit.

A private firm in charge of Shuttle operations and sharing in operational liability would be able to choose to self-insure for the potential loss or purchase insurance.¹⁴ NASA would therefore have to design a series of contract clauses that would properly balance risk assumption and profit potential.

¹³It is too early to determine the effect that the 9/11 tragedies will have on insurance industry capacity, but the initial reaction from the insurers and re-insurers was that the availability of funds would not drop precipitously.

¹⁴In the figures, the cost of insurance premiums is largely based on the reliability of the launch system. Since the reliability of the Shuttle system is quite high, it is likely that premiums would be charged at a lower rate than the expendable launch vehicles.